Issues on HW:

- 5c
- 5d
- 9 (finding $\bar{a}$)
- 15
- 17b (a-d)
- 5a

A car with a mass of 1300 kg is constructed so that its frame is supported by four springs. Each spring has a force constant of 20000 N/m. Two people riding in the car have a combined mass of 160 kg. Find the frequency of vibration of the car after it is driven over a pothole in the road.

$m = 1460\ kg$

$k = 20000\ N/m \Rightarrow k \text{ for problem} = 80000\ N/m$

$$f = \frac{1}{2\pi}\sqrt{\frac{k}{m}}$$

$$= \frac{1}{2\pi}\sqrt{\frac{80000\ N/m}{1460\ kg}}$$

$$= 1.18\ Hz$$

Energy in SHM:

$$K = \frac{1}{2}mv^2 = \frac{1}{2}m\left[\omega A\sin(\omega t+\varphi)\right]^2$$

$$= \frac{1}{2}m\omega^2A^2\sin^2(\omega t+\varphi)$$

$$U_s = \frac{1}{2}kx^2 = \frac{1}{2}k\left[A\cos(\omega t+\varphi)\right]^2$$

$$= \frac{1}{2}kA^2\cos^2(\omega t+\varphi)$$

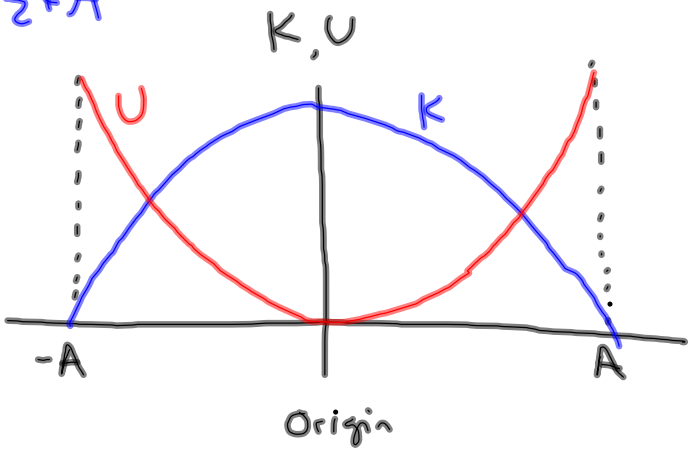
$$E = K+U$$

$$= \frac{1}{2}m\omega^2A^2\sin^2(\omega t+\varphi) + \frac{1}{2}kA^2\cos^2(\omega t+\varphi)$$

$\omega^2 = \frac{k}{m}$

$$= \frac{1}{2}kA^2\left[\sin^2(\ ) + \cos^2(\ )\right] \quad 1$$

$$= \frac{1}{2}kA^2$$



A 0.500 kg cart connected to a light spring for which the force constant is 20.0 N/m oscillates on a horizontal, frictionless air track.
a) Calculate the total energy of the system and the maximum speed of the cart if the amplitude of the motion is 3.00 cm.
b) What is the velocity of the cart when the position is 2.00 cm?
c) Compute the kinetic and potential energies of the system when the position is 2.00 cm.

a) $E = \frac{1}{2}kA^2$

$= \frac{1}{2}(20\ N/m)(.03\ m)^2$

$= 0.009\ J$

at $x = 0\ m$,

$E = \frac{1}{2}mv_{max}^2$

$v_{max} = \sqrt{\frac{2E}{m}} = \sqrt{\frac{2(.009\ J)}{(.5\ kg)}} = 0.19\ m/s$

b) $v = \pm\sqrt{\frac{k}{m}(A^2 - x^2)}$

$= \pm 0.141\ m/s$

c) $K = \frac{1}{2}mv^2 = .005\ J$

$U = \frac{1}{2}kx^2 = .004\ J$